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Resources for Tomorrow

Conference

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THE OTTAWA RIVER

by

Gustave Prévost

**A background paper on the multiple uses of
a typical drainage basin**

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SUMMARY

THE MULTI-PURPOSE OF THE OTTAWA RIVER

The Ottawa River which flows by the City of Ottawa before reaching Montreal, is fed by a drainage basin of 57,000 square miles. The uses that can be made of this whole area are many, whether they are recreational, industrial or domestic.

Nowadays, it is essential that the workers who toil in our cities in a strenuous atmosphere should have the opportunity to contemplate the beauties of nature in those places where they have been preserved in their natural state. Otherwise, we will have to remedy those mistakes we have made from an aesthetic point of view.

Bathing in a natural setting is much more enjoyable than in a swimming-pool where one usually finds an annoying promiscuity. Navigation on a river littered with vegetation and wastes of all kinds is not as interesting as on a watercourse where the water is clear and the banks clean. Fishing is profitable and fun in a river where the biological balance has been preserved. Water is indispensable to life. It must therefore be free from pathogenic organisms. Unfortunately, this is not the case with the Ottawa River and many of its tributaries. Water is also essential for the irrigation of land; however, it will gather a large amount of fertilizers, insecticides and herbicides that could be harmful to man and animals. To industry, water is extremely useful, we could say indispensable. With the building of dams, it gives us electric power. The pulp and paper industry relies on water as a production requirement. It is used in the mining and textile industries, etc.

Just about everything we touch has needed water for its existence at one stage or another.

If water is to fulfill its maximum purpose, it has to be as pure as possible. Unfortunately, the waters of the Ottawa River are polluted, because we have allowed the discharge of all kinds of wastes in the river without any treatment. We must therefore build treatment plants which will reduce considerably the extent of the pollution and will make this river "habitable". It is important to make a detailed survey of all the resources of that region and establish a logical plan based on the findings of many experts: architects, landscape-architects, biologists, engineers, sociologists, etc.

To achieve these goals, we must convince our leaders and the general public that without scientific research and cooperation we shall be unable to arrive at a successful issue which means the maximum utilization of the resources of that region without endangering the prosperity of the future generations.

As far as the Ottawa River is concerned, it is imperative for the Province of Quebec and the Province of Ontario to enact the same policy especially in connection with the control of the pollution of water.

THE HISTORY OF THE UNITED STATES

The first of the great events of the American Revolution was the Declaration of Independence, which was adopted by the Continental Congress on July 4, 1776. This document declared that the thirteen colonies were no longer subject to British rule, and that they were now free and independent states.

The second of the great events of the American Revolution was the Battle of Bunker's Hill, which was fought on September 17, 1776. This battle was a tactical draw, but it showed that the Continental Army was now capable of standing up to the British in a conventional battle.

The third of the great events of the American Revolution was the signing of the Treaty of Paris, which was signed on September 3, 1783. This treaty ended the war and recognized the independence of the United States. The treaty also set the boundaries of the new nation, which stretched from the Atlantic Ocean to the Rocky Mountains, and from the Gulf of Mexico to the Canadian border.

The fourth of the great events of the American Revolution was the adoption of the Constitution, which was signed on September 17, 1787. This document established the framework of the federal government, and it has since been amended to reflect the needs of the nation.

The fifth of the great events of the American Revolution was the signing of the Declaration of Sentiments, which was signed on August 26, 1848. This document declared that women were equal to men in all rights, and it was a major step in the fight for women's suffrage.

The sixth of the great events of the American Revolution was the signing of the Emancipation Proclamation, which was signed on January 31, 1863. This document declared that all slaves in the United States were now free, and it was a major step in the fight for civil rights.

The seventh of the great events of the American Revolution was the signing of the Civil Rights Act, which was signed on July 2, 1964. This act prohibited discrimination on the basis of race, color, religion, and sex, and it was a major step in the fight for civil rights.

NATIONAL RESOURCES CONFERENCE

Resources for tomorrow

Background paper : A typical drainage basin :

The Ottawa River.

By : Gustave Prévost, chairman
Quebec Water Purification Board.

Our assignment is to give a picture of the present uses of the Ottawa River and to review the factors that should be studied to secure the best returns in the future. But we cannot study the river without also studying its watershed. Some part of every drop of water falling in the watershed finally reaches the Ottawa River, and what happens to that drop of water in its long journey, its chemical or physical change, will dictate the use we can make of the river. At a certain degree of pollution, water can have no use at all. Life in the region could be doomed. We must therefore endeavour to (find the best use of this water, for the benefit of the majority of people now and in the future).

A term in honour nowadays is "multiple use". But there are limits, since an attempt to multiply uses may mean sacrificing some very useful single use. On the other hand, an attempt to overdo a single use may jeopardize other uses, present and future. What we really must aim for in any specific field is not maximum but optimum use. We must keep a sound balance among the different uses of the water and a safety margin for future possibilities. With watchfulness as our keynote, and after mature consideration of all the factors involved, we must decide the rational planning of our future resources. That is the long-term aim.

For the time being, however, all we can do in most of the cases is postulate general principles and raise a number of questions which may only be answered by teams of scientists after long and methodical research. Every participant at this conference could with advantage have been invited to cooperate in the presentation of this paper, since every one has a share in it. A difficult task, indeed, has been placed on our shoulders ; and our attempt to fulfil it requires your indulgence. We could get to the core of the subject right away, speaking of the actual use of the land and the water ; but we feel that the philosophy of planning will be easier to understand if first we give a description of the area and its history. We do so briefly, and append a bibliography for those who may wish to have more information.

In this bird's eye study we will mostly consider the Quebec side, although we will refer occasionally to the Ontario side.

DESCRIPTION AND HISTORY OF THE RIVER AND ITS WATERSHED

The Ottawa River takes its main source at the Great Lake Victoria, about 150 miles north of Ottawa. It flows 700 miles in a meandering course through Ottawa, and enlarges itself in a big lake, Lac des Deux-Montagnes, and encircles the island of Montreal, where it joins the St. Lawrence River. The watershed is about 40,000 square miles on the Quebec side and 17,000 square miles on the Ontario side. These two sides offer some geological contrast. The Quebec part is mostly in the Canadian Shield, characterized as every one knows by rock outcrops, minerals, stony soils, lakes and forests, so that in the beginning, at least, lumber should be the top exploitation and agriculture minimal. But a great part of the watershed on the Ontario side is in the Saint Lawrence plain, characterized by fine textured, dark grey, gleysolic soils and podzols ; here agriculture is the natural, the top use, after forest clearance.

The respective silhouettes of the two watersheds are easily imagined. The Canadian Shield is mostly precambrian ; it is hilly on account of the last resurgence of the land, but with glaciation the hilltops have been cut down, the highest being Mt. Tremblant, 3,200 feet above sea level. The average altitude is only 1,000 feet. The Canadian Shield line passes at the upper limit of St. Jerome, Lachute and proceeds to Calumet, where a narrow band goes to Petawawa and down on Ontario side in direction of Lanark. So the rest of the watershed is in the St. Lawrence plain and is known as the Lower Ottawa Valley. Here there is clay and the land is generally flat, the Champlain Sea covered all the area about 10,000 years ago and, in withdrawing, left loose sediments.

The general elevation is between 100 or 200 feet ; the limit is 500 feet. In the Canadian Shield there are thousands of lakes among the numerous hills, found mostly on the Quebec side. But the Ottawa Valley plain has evenly few lakes.

The average precipitation is 35 inches, rather evenly spread over the year although generally lower between July and October. From this it follows that the Quebec side is well irrigated ; the lakes overflow in cascading rivers and take a great amount of water down to the Ottawa River. But if the Canadian Shield has fair distribution of water all over the land, with good irrigation, a different situation exists in the plain, especially on the Ontario side, where there are a few rivers and the land is flat ; this part is exposed to poor irrigation in the summer and flooding in the spring or in time of heavy storms.

The air temperature may vary from below zero over 90° Fahrenheit frost may persist 6 months in the Victoria Lake district but only 4 months in Montreal area.

The earliest known inhabitants of the wilderness of which this basin was originally constituted were the Indians, the Algonquins, who probably lived there for many centuries before the arrival of the Europeans at the beginning of the 17th century.

The Ottawa River was first mentioned by Champlain in 1603, and ascended by him in 1613 ; the first European who ascended it was Etienne Brulé, in 1610. In 1611, Nicholas de Vignon reached Allumettes Islands, occupied then by an important settlement of Indians from 1600 to 1760.

The Ottawa River was used as a route to the Great Lakes ; it was more easily travelled than the treacherous St. Lawrence. The Ottawa River was continuously used by fur traders, explorers and missionaries up to the beginning of the 19th century.

The first settler was Joseph Mondion, at Chat Falls, in 1776. An American, Philemon Wright, came to Hull in 1800. Later came the United Empire Loyalists and others from the United States, groups from the British Isles, soldiers and French farmers from the Montreal area.

In 1827, an establishment took the name of Bytown. It was in honour of the colonel commanding the Royal Engineers who built the Rideau canal. It was renamed Ottawa in 1855 in honour of the Outaouais Indians. Queen Victoria chose this city as the capital of the United Canada in 1857, a decision which drew many Scottish and Irish settlers to Ontario and to Argenteuil County on the Quebec side.

The lumber industry and agriculture were the main occupation of the people and the population increased fast, since the valley could supply the wealth for which they sought. The population, about 150 in 1800, had reached 100,000 in 1850 ; now it exceeds 1,300,000. If we count the population of Montreal area which in fact, must be considered as part of the Ottawa River, since the water which encircles the Island, comes from that river practically, we find more than 3,000,000 people living on a stretch of land some 150 miles by 30 miles ; they constitute more than $\frac{2}{5}$ of the population of the province. Thus we can see the importance of the river and of its watershed and why we should protect them, especially when we know that the forecast for 1990 is in the order of 8,000,000 persons for that area.

The map (figp.22) shows the distribution of the population, the location of pulp and paper industries, mostly around Hull, and the mines, mostly in the Abitibi district. Roads are scarce on the Quebec side, although there are many good logging roads for forest explorations. Dams are numerous for power purposes or log transportation. There is a Federal Park on the Gatineau River and three Quebec Provincial Parks, La Vérendrye, Mont Tremblant and Kipawa ; on the Ontario side there is a provincial park known as Algonquin Park. They are used for recreation, but forest exploitation is permitted, except on the Gatineau. Many territories on the Quebec side are leased to anglers and hunters. There is good agriculture in the Ottawa Valley but little in the Canadian Shield. Navigation is scant. The watershed on the Quebec side has been called the playground of North America. So one can see the impact of all that population and its activities on the water of the basin and of the Ottawa River itself. With this general picture in mind, let us see a little more precisely what is being done in this area, and what could best be done with it in the future in the meaning of today's expressive general term multiple-use.

MULTIPLE USE OF WATER

What exactly do we mean by "multiple use" of water ? It is customary to include domestic purposes, fish production, recreation and industry. However we would like to be more specific and ask you to consider six different uses, ranging from the non-detrimental such as quiet contemplation to the potentially dangerous such as waste disposal.

We realize that in our materialistic world it may be a little difficult to convince everyone of the need to spend money to keep our water as pure as possible when there is no immediate or obvious prospect of financial gain. We might be labelled idealists, but without idealistic goals there cannot be much improvement. This conference has been called to set up the highest possible standards. Accordingly, we should not restrict ourselves to immediate practical benefits but try to lay down sound conservation principles for the guidance of those promoting any future project. We will therefore ask you to examine the following six broad categories of uses.

1. Contemplation
2. Bathing
3. Hunting and fishing
4. Navigation
5. Water supply
6. Waste disposal.

1. Contemplation

What can be more beautiful than a clear, sparkling stream, lightly running over cascades and rapids, surrounded by verdant trees, wildflowers, mossy rocks, craggy mountains ? Even more so where man has not interfered with nature and altered the habitat ! Virgin country has a special appeal to the soul and for the benefit of man we should preserve certain districts in their natural state, as it is done in many parts of the world in National Parks. Keeping the habitat unaltered does not preclude prevention of disease by removing diseased trees or other preventive or corrective measures.

If alterations have to be made for the sake of other benefits, let us attempt everything in our power to preserve aesthetic values.

From a practical point of view, by keeping certain districts unaltered, especially at the source of tributaries, we shall have the added advantage of storing water in the vegetation-covered ground, thus regulating the steady flow to the lower lands.

To enhance the more beautiful sites, landscape architects, biologists and engineers should work in teams. Trails can then be laid out in the most appropriate manner without affecting the existing biological balance of life. Where motor roads are required, they should be built as narrow as possible, within safe limits. One-way roads appear the most logical to avoid cutting too big a break through forest land. Picnic tables, restrooms and adequate shelters should be provided. Building permits for larger installations, such as hotels or restaurants, should always embody specifications laid down by a board of government specialists to ensure that they are in keeping with the general aesthetic level of the region. No foreign matter, no trash, should be allowed to go in the waters. Aside from water damage, floating debris is an eyesore ; it may also encourage overgrowth of weeds.

More land for such recreation will be required, especially around towns where 80 % of the people will live a few years hence.

As an accessory to contemplation, historical sites should be put in evidence, e.g., the site of the Dollard Desormeaux Fort near Carillon. Deep River, near Chalk River, recently yielded the archeological remains of an Indian outpost of 3,000 years ago. These and other worthwhile features of the watershed should be developed. Painters, photographers, green theater, open air concerts, artists of all kinds should be encouraged to frequent the appropriate surroundings. All quiet sports should be developed, such as hiking, horseback riding and so on. All these activities are priceless when performed near a lake or a spring of pure water. Here we can see the effect of the water on each activity of our life. Nature study, such as botany, geology, zoology, camera hunting, should be encouraged, as well as skindiving for underwater observation. By the same token we will relieve the pressure on fishing and hunting by directing more people to other activities.

Community leaders should try to develop those activities as much as possible. Leaders of some industries have taken special care in planning their company towns to make people happy to live there ; this way of thinking should be spread all over the area. This is a good investment against mental illness.

For the dollar man, let us observe that such an approach is an asset. It brings more inhabitants to the area, since it is so well planned. The demand for aesthetic values will be greater tomorrow than today. Leisure is on the increase ; with more people, there will be more money. A promoter planning to open a new area should have in mind not only the immediate industry but also all other values which will make industry prosperous. Human beings must come first in his mind ; gone are the times when some industrialists used to pack labourers in shacks with no convenience and no social or cultural activity.

Ottawa has a good town-planning scheme although still in its infancy. . It will set a fine example when completed. But how much more is still to be accomplished in the remainder of the Ottawa River basin, including Montreal, before the habitat can be made more pleasant for

human beings.

In our province, public recreation places close to municipalities are very scarce ; let us hope that there will be other opportunities such as the acquisition of Soulanges Canal and its surroundings, located only 25 miles from the metropolis, which will make a wonderful park for the average Montrealer. We need more and more open spaces for a general public that has more time and greater inclination to visit recreational and educational areas. It is regrettable that between Montreal and Hull there is no managed area for the public. Of course, with the quality of the water being such as it is, one should not be greatly surprised. Some people have even been obliged to sell homes they had just built, because of the unbearable odours that invaded their rooms and the offensive refuse of all nature that settled in beaches and bays. No statistics have yet been tabulated to ascertain the loss of value of these properties but it must surely run into millions of dollars.

2. Bathing

The pure limpid waters of a virgin stream have strong attractions for human beings, and bathing is of great recreational value. Public areas must be made available for bathing. The ideal is a sandy beach. If not already existing in the natural state, artificial beaches should be made in accessible areas. The number of people using each one should be limited, so that promiscuity can be avoided and life made more enjoyable for the majority. Big bathing developments should be located far enough from residential districts which should be spared the noises which usually accompany such areas.

Some administrators have advocated that rivers are the property of no one in particular, so there is no objection to their use as sewers ; if the water becomes unhealthy, let us forbid bathing and tell the people to build swimming pools. Everyone can see the shortcomings of such a state of mind. First, it is not everyone who likes to bathe in a swimming pool, where there is promiscuity, and where the water may be safe at the beginning of the day but may contain many pathogenic germs later on after hundreds of people have bathed. This may even happen in a river bay, where there is plenty of sunshine to reduce the virulence of pathogenic germs. Although typhoid cases have grown rare, doctors do report lots of skin, nose and ear troubles in summer months on account of bathing in waters more or less reliable. And the enforcement of a "no bathing" rule is difficult, especially with children living in summer houses scattered all along the river. But bathing is not the only activity which should be prohibited ; water skiing is another, since a person cannot practice it without sometimes being in the water ; also people accidentally fall into the water from a boat or from any other place.

Are we going to let the water deteriorate to a point where the Ottawa River cannot be approached safely ? This unfortunately is already the case in many places, as mentioned in Piché's report of 1956. And pollution has steadily increased since then with the increase of population and industry ; more sewage has not^{been} matched with an overall increase in the flow of water, but there has been the accustomed seasonal decrease. The U.S. Health Department has declared that the bacteria count for

swimming purposes should not exceed 1,000 per c.c., but at places, on the Ottawa River and North River, the count has been found higher than 24,000 so there is practically no decent public beach along these rivers. Aside from the hazard of bacteria, swimming can be ruined by oil and other dumping : equally damaging is weed overgrowth.

Bathing cannot impair the quality of the water in the Ottawa River and its tributaries, unless there should occur a tremendous con-course of people within a relatively small bay. The habitat of the fish could be disturbed as a result, but the disturbance is likely to be only temporary. Even if these circumstances became permanent, there is a good case for overlooking any possible damage, when one balances the small area given up against the high value of the recreational facilities it affords. However to prevent disturbance of an important fish-spawning area, a beach might have to be placed elsewhere, since the habits of fish cannot easily be changed without prejudice to the species.

3. Hunting and Fishing

The Ottawa River supports fish, birds and mammals. To maintain a balance, the natural habitat should be preserved in as primitive a state as possible. We are often in the dark as to the effects of changes we bring into this balance of nature ; we do not always know how best to counteract the harm we may be doing.

Pollution is of course the great enemy of aquatic life ; it may kill many food organisms used by fish or the fish themselves ; it may drive them away or predispose them to diseases. Some undesirable species will multiply and supplant game fishes.

Hunting and fishing are of great value in the recreational field. Their economic importance can be assessed when it is remembered that tourism ranks third as a source of revenue to Canada and is said to represent currently a turnover of \$100 millions a year in the province of Quebec alone.

For many years the government has undertaken a policy of granting hunting and fishing concessions and rents, for five years leases, certain territories to private or commercial, clubs (the latter acting as hotel keepers). Until now these clubs have generally contributed by their vigilance, to the preservation of our fish and game. Indeed we have witnessed that when a fishing territory was handed over to the general public it was soon ruined beyond repair.

On the other hand this does not mean that we should necessarily pursue this policy of concessions. In any case, the government is each year breaking up the clubs and obliging a number of them to increase their membership. Perhaps it might be wise to consider renting at nominal cost certain territories to fishing and hunting associations or to other such conservation minded groups.

In some parks, hunting is forbidden and this is assuredly a blessing for campers, nature lovers, bathers and others. Yet this should

not mean that no animal may ever be killed in times of food shortage or considerable biological imbalance. This is where ecologists must play an important part in policy making.

Our legislation on hunting and fishing is mostly based on intuition and tradition rather than on scientific data. We have very few statistics. Generally speaking, we cannot even say with any authority how many fish live in a river or lake, or how many we can take out without impairing the survival of the species. It may be that we remove too many or not enough or perhaps a large number die of natural death with no benefit to mankind.

Some people think all we need to ensure good fishing is to restock a river with desirable fish. But each species of animal has so many requirements for survival that our restocking is too often disappointing.

As for the other animals, such as deer, moose, etc. all are affected by contaminated water. Aquatic birds such as ducks can die from an oil slick ; we had a holocaust from this cause a few years ago.

Among the fish found in the Ottawa River and the tributaries, sturgeon (Acipenser fulvescens) is the most important for commercial fishing ; small-mouth black bass (Micropterus dolomieu), walleye pike (Stizostedion vitreum) northern pike (Esox lucius), lake trout (Salvelinus namaycush), muskellunge (Esox maskinonge), for sport fishing. In the main tributaries, especially the upper one, we have speckled trout (Salvelinus fontinalis) and in the Riviere Rouge and North River, brown trout (Salmo fario) have been introduced. Let us also mention Quebec Red trout (Salvelinus marstoni) in Marble Lake and a few others ; on Ontario side, we find also mouth black bass, bluegill, pikes, etc... There are two interesting species which are not found either in the Eastern or Western provinces. These are the beaver fish (Amia calva) and the longnose gar (Lepisosteus osseus). They belong to species that lived in prehistoric times, about two hundred millions years ago.

Introduction of exotic fish must be made with great caution. No one should ever be allowed to restock without special permit from the Ministry. No minnows should be transported from one place to another, since many lakes have been spoiled by undesirable fish which displace game fish or spread parasites, Millions of dollars in tourist trade could be lost through ignorance, carelessness or neglect.

Our fishing legislation unfortunately follows our hunting regulations and the dates of opening and closing of the season usually coincide with breeding. In the field of hunting, where the hunter sees the animal, it is fairly easy to abide by the law ; in the field of fishing this is not the case : a fisherman may be allowed to fish in certain districts but is not permitted to keep certain species. So he must release the banned fish which, in most cases, only means the fish will die soon after. The interests of conservation have not really been served.

But if we truly want to protect a given species, spawning territories should be completely closed to fishing. Entire rivers or lakes could thus be out of bounds at certain periods. On the other hand, where population and reproduction rates are high, there should be no objection to an open fishing season all the year round. What really counts in the end is the creel limit ; each fish taken, whether in or out of spawningseason, is one fish less in the water.

There can be no sound legislation until we know a great deal more about our fishes, their habitat and their relation to other organisms. Reliable statistics will have to be kept of their populations, sizes and ages.

For bird hunting we should reserve large ponds on the margin of the river, especially around Carillon in the flooded area produced by a new dam. This could provide an attractive ground.

For the propagation of mammals, some of which, muskrats for instance, are important revenue producers, special areas should also be provided. Marshes should not all be drained as agricultural fields are often a lesser source of revenue ; draining can even be detrimental by removing a natural water reservoir which may be necessary to agriculture itself. Beavers once were Canada's wealth, but now their value is down and their numbers are up ; they build dams in many places and sometimes are troublesome.

In some cases the raising of the water level can be favorable for the development of game fish, but it can often be detrimental.

The fashion for farm ponds incites many people to build them. These ponds beautify properties and can, at the same time, bring an appreciable income from the fish they may raise. On the other hand, the multiplication of theses ponds, usually built on small streams, can contribute to the raising of the water temperature and provoke disturbances among the organisms that require a very specific temperature for their well-being. Therefore serious research should be carried out before over-popularizing the construction of these ponds which, on their own merit, are excellent. In any case, a permit must be sought from the Department of Fish and Game before construction can proceed.

4. Navigation

Navigation has always been, and still remains of prime importance to Canada. The canoes of the "voyageurs" opened the country and their "bateaux" supplied the first settlers.

The Ottawa River can accommodate vessels of 9 feet draught right up to the city of Ottawa, with four canals on the way ; the total length is 125 miles. Dams and waterfalls preclude navigation in the upper reaches, although since 1837 the Rideau canal has provided transit to the St. Lawrence River through Kingston for boats of 5 $\frac{1}{2}$ feet draught. In 1908, a canal system project was studied to afford communication with Georgian Bay ; it was shelved at the time but it was revived by the federal government in 1960.

The Ottawa River last year carried 335,000 tons of merchandise against 22 millions on the St. Lawrence. The total traffic is not great, but direct communication with Georgian Bay would greatly increase it.

The river is also used extensively by pleasure craft and, in the upper reaches, pulpwood is floated downstream.

Between Ottawa and Montreal there are a few locks, which means damage to the riverbed and interference with the habitat of fish. Where dredging has been performed, the same effect has resulted. The latter operations also stir up matter in suspension to the detriment of the river's amenities, beaches and fishing facilities.

This damage cannot be entirely prevented, but much can be done to reduce it. For instance, by using suction dredgers, the material removed from the bed of the river could be deposited in barges and the silt transferred to settling basins instead of being simply reshuffled within the river.

The transit of boats on a river does not affect the habitat of wildlife but when we build locks we may allow passage to undesirable fish. This occurred in the Welland Canal which opened a way for lamprey right up to Lakes Erie, Huron, Michigan and Superior. As a result, lake trout has practically disappeared under the attack of that parasite. Misfortunes of this kind are not easily foreseen or prevented, but research should give considerable help.

Motorboats themselves do not in general affect fishing, although they could be a nuisance to some extent; in great numbers they could change the composition of water and be the cause of phenolic products; dumping of oil should be prevented. An oil slick can be a navigation hazard; dumped organic wastes can cause a weedy overgrowth that may jam the propellers of small craft.

Similarly, constant invasion of waterfowl habitats by boating parties or motorists would eventually drive them away.

Some restrictions should be made as to the kind of motors in use, to reduce the noise, since people who "go to the country" install themselves along the river or a lake for tranquility and to be far from the noises they have been living with in the city.

It has been demonstrated that noise is a great factor in the nervous condition of many people; so noisy boats should be forbidden and their traffic should be limited to certain routes, not being admitted, for instance, within a certain distance of shores outside of their immediate property, except in an emergency. The same regulations should apply to sea planes. Good safety measures should be reinforced and no waste of any kind should be dumped overboard. Commercial navigation, especially around Montreal, should be checked carefully,

especially for the prevention of oil dumping and, it would seem desirable to forbid ships to sail from harbours at night, since they can easily perform that operation without great danger of being caught.

5. Water Supply

In the four preceding chapters on contemplation, bathing, hunting, fishing and navigation we have not changed the nature of the water of the habitat, except for building artificial beaches or locks for boats, where the flow of water in itself was not of great importance. But now we must consider a use in which the flow is highly important to the economic development of Canada, such as for driving turbines to produce electricity, or for industrial processes, and for domestic uses. For all these needs the Ottawa Basin can only supply the amount of water which it will receive from the sky ; and as only some 25 % of the water received, will reach the streams, it follows that we need a great amount of rain or snow to supply our needs ; we also require a drainage basin well provided with spongy texture to retain water and deliver it slowly and regularly all year round.

In respect of rainfall the watershed is fortunate ; on the Quebec side alone there is an average of 35 inches of water per year for a total of 40,000 square miles, which provides approximately a maximum flow of 300,000 cubic feet and a minimum of 30,000 cubic feet at Grenville.

This flow of water is the life of all the basin, like the flow of blood in our veins. Without it, very little development could have taken place. But the water needs to be managed for its best use.

Domestic uses

a) Drinking purposes

Water serves many purposes. First and ^qmost it must keep us and every other living organisms alive. The simple fact of taking it from a stream causes no damage, unless the pipes draw off too much of it, thus lowering the water level which could provoke the death of the aquatic fauna and flora.

Spring water can generally be drunk without prior treatment, but water from the Ottawa River or many of its tributaries must be treated before it is fit for use. The danger of a breakdown or human error in the purifying processes cannot be over-emphasized. It is odd to have to admit that progress and expansion have driven us to drink water which has previously been through sewers. There is no doubt that people would prefer to use water coming from a lake or a river, where no human excrement has been deposited and the day may not be too far when we will be obliged to draw the water from Laurentian Lakes instead of the Ottawa River ; we may be like a man at St. Jerome, who left the country in order to enjoy city amenities, but found he must draw water from the farm he had left.

b) Cooking

Pure water is indispensable to the cooking of food, otherwise there might be contamination. It is true that boiled water is free from a good number of pathogenic organisms, but what about the viruses which are now being found in ever greater quantities since systematic research is being carried out ?

c) Washing

Washing crockery, laundry or floors with polluted water is not an attractive thought. One might even soil what one wanted to clean.

In the city of Montreal, more than 300,000 gallons of water per day are used for the above mentioned three purposes. A volume of 100 gallons of water per day per person is the usual allotment. All this water, mostly soiled, must run off somewhere. It cannot be stored in one's cellar. In scantily populated places where the soil is adequate, it is directed to a cesspool from which it slowly filters through sand or soil and purifies itself. If there is a freshwater well in the vicinity it may be contaminated but there is no danger when the cesspool is sited some distance away, say about 150 feet. In the case of non-permeable land, septic tanks can be used, either of metal or cement, with French drains situated over a distance great enough to allow complete absorption of the decanted liquids.

These tanks must be carefully watched to prevent contamination and offensive odours which spoil all the pleasure of a stay in the country. When the population is concentrated and considerable, sewers are required and this is where the trouble begins.

You start with a small pipe running off into a ditch and to this first pipe many others are added. All this takes place in the open and gives out a foul swell. In this, insects, rats and of course the germs of all manner of disease soon breed. This sight occurs in the middle of a town. If one could find the time to compile records of the state of health of the citizens of a municipality and the degree of pollution of the air and water, one shouldn't be surprised to find that the incidence of ill-health is always higher in badly run municipalities.

Many people think all you have to do is run the sewers straight into the nearest river or lake. Dumps are even sited along ravines, so that the first rain will wash everything down. Tons of wastes have been tipped into certain sections of the Ottawa River day after day for years, thus contributing to pollute the waters and cause untold damages : increase in the aquatic vegetation due to the fertilizing substances of these wastes, displacement or death of game fish, depreciation of properties and so on...

Yet all of this can be avoided to a large extent by the construction of purification plants. With today's modern technique and at a reasonable cost, a purification of 85 to 90 % can be attained.

Agriculture

Agriculture may often be established at the cost of also producing erosion-caused pollution ; this is because in our country we must clear the forest in order to create arable land, and in so doing we may destroy the spongy water retaining mantle. To prevent erosion in hilly places good farming methods must be developed. In flat areas, drainage is done to get the water out of the fields, but the water table must not be lowered so much that in the end agriculture itself must suffer. Before draining, one must consider if the inundated or marsh area is not better suited to, say, the development of a fur industry, such as muskrat raising, or to bird hunting, by attracting ducks.

All those practices have to be taken in consideration, because they have a great effect on the conservation of our water, and areas of forest and vegetation must be kept so that, by retaining water, they ensure a slow and regular flow ; this in many instances could replace costly man-made reservoirs. Ploughing methods such as contour ploughing instead of up and down, may help keep water in the fields. Since fertilizers, insecticides and herbicides are used in agriculture, a part of those products is washed down by rain or melting snow and drained to rivers or lakes ; organisms may die as a result, or there may be increased fertility in the waters, sometimes detrimentally, so because it provokes an increase of aquatic weeds or kills or drives away some species of aquatic organisms. This would come more from the Ontario side, where there is more agricultural land. So the minimum dosage of chemicals must be used and there must be research to find products harmless to aquatic life.

Domestic animals, especially cows, should not be allowed to come near streams, which they pollute ; those streams should be fenced - of course, no dead animal should be thrown in a stream as has happened too frequently.

Milk and cream plants which are practically in every village, and cheese plants should not throw down the drains their washing waters which are very rich in organic matter and have a very bad effect. Of course, all the wastes from any agricultural practice should receive some treatment before being released.

Industrial purposes

Water uses for all kinds of industrial purposes are tremendous in the Ottawa River basin. Let us run through the main ones :

a) Electric power

The first electric power ever used in Canada was on the Ottawa at Pembroke. The use has both spread and multiplied since then ; the drop in level between the Dezois Reservoir and the St. Lawrence River at Montreal is 1100 feet. A river with so many gradients may be harnessed to turbines and generators by means of dams in series.

The total volume of water stored in the reservoirs on the Ottawa River exceeds 11 million acre feet (Water Resources . .) of which $9\frac{1}{2}$ million are in Quebec and $1\frac{1}{2}$ million in Ontario.

The total capacity of hydro electric power is just over 2.8 million H.P. ; the only important dam that can be added to those already built is actually under construction at Carillon ; it will increase the horsepower capacity by 840,000 H.P., thus raising the overall total to 3,640,000 H.P.. The province of Ontario extracts a capacity of 1,294,672 H.P. from the Ottawa River and Quebec 1,507,904 H.P.. The river's power resources are one of Canada's great assets to the country as a whole.

In addition to these dams on the river itself, there are many others on the main tributaries which thus build up large water reserves. Some of these dams serve private interests. Their site and their capacity should be determined by provincial authorities, so that they may best benefit both public and private interests.

The effect of dams on environment is extensive, they should be fully considered both at the time of building and during exploitation.

Generally speaking, dams, especially deep ones, result in extensive flooding of the adjacent land areas. These lands are mostly covered in forests and up to now it has not been the general practice to cut the timber before flooding. This is a great pity because the trees left underwater can release considerable quantities of tannic acid which may destroy or drive away aquatic organisms, particularly fish. It would therefore be most desirable, when economically feasible, that as much timber as possible be removed prior to flooding, not only for the value of the logs, but also because of the possibly disastrous consequences of leaving submerged trees. From a simple esthetic point of view and for the sake of navigation, the stumps should be taken away.

The manner of operating these dams is very important. Water should be allowed to overflow from the retaining wall at a constant speed. If the sluices are closed and the level of water in the river is greatly lowered, aquatic organisms will be exposed and die. If, on the other hand, floodgates are opened too fast, the rushing water will carry everything away ; the living organisms will be displaced by the violent current.

So the stream of water must be carefully checked. Thus, where there are dams on several tributaries, concerted action is required and a number of sluice gates should be operated simultaneously.

Each will only let through a small volume of water which, when cumulated, will satisfy the needs of the hydroelectric station. Otherwise, a rapid lowering of water level in the reservoir would leave too many organisms high and dry and destroy fish food.

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The bottom water of reservoirs has generally a low oxygen content and can cause asphyxiation of the fish. Added to this, water that is feeding the river is usually drawn from the bottom of the reservoir so that further deoxygenated water is brought in. In some cases, it might be necessary to oxygenate this water artificially for the sake of the fish and other animals.

In heavily populated districts where pollution is considerable, an accumulation of waste material can collect in the waters impounded by the dams ; occasional draining is required. The wastes should then be sucked out and removed elsewhere ; this is better than simply opening the floodgates and releasing the trash into the river where it may kill many fish and impair the welfare of riverside inhabitants.

A number of dams in the United States have failed in their expectations by silting up and becoming useless in a few years.

If dams do not stop fish from going downriver, they do prevent their ascent ; the law therefore requires dam owners to install fishways. Such fishways are necessary, even vital to the reproduction cycle of salmon, but they are not essential for the kinds of fish found in the Ottawa River and its drainage basin. In some cases they might be useful, but also they may be harmful when they allow passage to undesirable species of fish. Instead of obliging companies to build fishways for species of fish other than salmon, and until means have been found to make efficient ones, it would be better to require from the companies payment of a grant towards scientific research into the effects of the dams on habitat. This contribution could be proportioned to the companies' turnover. If a dam caused fish losses, the operator should prevent that and if for some reason, it were impossible he should be made to replace them by artificial restocking or by setting up other fishing areas as much as possible in the immediate neighborhood.

Fish shooting over a dam from a certain height would kill themselves if they fell on solid ground, but when dropping into water, they easily survive if not too big. Plantings carried out by plane, dropping fish from 100, 200 feet or even higher, have shown no mortality ; this was first demonstrated in 1936 in Quebec (Prévost).

What can be said of turbines ? Many people think they act as meat grinders ; that fish caught in them are minced. Experiments have shown that in slow-motion turbines, such as the Francis type, fish pass through easily without damage (Prévost).

Another form of damage that can result from the damming of a river, if the dam be deep enough, is that of changing the river into a lake. Angling sites will then disappear, the aquatic life will be altered, fish species will no longer find the same environment, and species that thrive better in running waters may no longer be caught. On the other hand, for some species, a reservoir, when well planned, may offer several advantages over a river, such as increased food supply, greater living space and so on, and at the same time can provide a great recreational area.

b) Atomic energy

With the development of atomic energy aiming at supplementing if not supplanting hydro-electric power, we must expect radioactive wastes to reach the rivers. Some radioactivity, not considered to be at a dangerous level, has been detected near the Chalk River atomic energy plant. Our concern must increase as more such plants are built. It is not possible to assess a safe ceiling for a given radioactive element ; animals, such as mollusks, can concentrate some elements up to 600,000 the amount dissolved in water and if this mollusk is eaten by a fish, which later is eaten by man, the radioactive element will finally get into the human system and may cause damage or death. There must be a close, regular check of radioactivity, especially on the Ottawa River, by a skilled team of scientists. This is already being done at Chalk River, but the number of men should be increased.

c) Forestry and related products

The exploitation of the forest is the greatest activity of that watershed. In the year 1959-60, a total of 120,000,000 cubic feet of wood has been cut, on the Quebec side, and 70 % of that wood consisted of spruce (*Picea glauca*, *Picea rubra*, *Picea mariana*) and balsam (*Abies balsama*). The greatest activity was along the Ottawa River, where around 24,000,000 cubic feet were cut and the Gatineau River 14,000,000.

The map shows the concentration of work in the different areas, as well as the different saw mills installed. Most of the resinous woods are used for making pulp and paper, and are floated down the tributaries and the Ottawa River. By this operation, much of the bark leaves the wood and drops to the bottom of the rivers and lakes ; the bark deposit may ruin the fish habitat, and the tannic acid and other dissolved material may also cause havoc by changing the composition of the water.

Many dams open at the proper time to control the flow of the wood downstream resulting in the same damage that we mentioned concerning power dams. Dynamite is often used to break a log jam in rapids and fish may be killed. Some logs sink and smother the bottom ; they may destroy spawning beds and ruin the fish habitat.

An illegal practice by some companies, one difficult to control, is that of soaking the bark off the logs by prolonged immersion ; the result is a lighter burden on the debarking mill but a littered river bottom. More and more, however, transportation is done by truck ; we may hope that before long all wood will be moved this way. Let us also hope that an economic method of debarking trees on the spot will be found. But we must bear in mind that bark left on slopes as loose material will have to be burned or buried so that rain or melting snow will not wash it down into the streams.

Sawdust from sawmills should not be placed along the banks of a stream or a lake, and a law should specify the location for each of these. Today, several industries burn their bark in modern furnaces and are able to recover steam-heat which they can use in their manufacturing processes. So much the better for the purity of our rivers !

The main mills are located at Ottawa, Hull, Gatineau, Temiscaming, Buckingham, Masson, Hawkesbury, St. Jerome and Mt. Rolland. They require vast quantities of water for the manufacturing process of the pulp and paper industry. It is important that their water should be as pure as possible otherwise they will have to treat it at extra cost. These industries might eventually have to move elsewhere if they cannot find adequate supplies of water.

Road building usually calls for tree felling, dynamiting, and displacement of gravel. One often overlooks the fact that this will usually hasten erosion, especially in the proximity of a stream. Bulldozers and other earthmovers should not be allowed to clutter rivers with loose material which will ruin the aquatic habitat. Road embankments, railway tracks and abandoned roads should be seeded or replanted to prevent erosion.

The use of pesticides to destroy harmful insects is a great threat to aquatic organisms and other fauna. After spraying with D.D.T. or similar products by air, these substances lay on the ground and are carried away by the next rainfall into the streams where they gather in concentrations strong enough to destroy aquatic organisms. Quantities must therefore be limited to a strict minimum and aerial operations carefully watched to prevent all possibility of a pilot unloading his whole cargo in some spot to get rid of it quickly, as has happened in the past.

For newsprint production one mill alone discharges to the Ottawa River, 7,000 tons per year of fibres, 20,000 tons of bark and 1,000,000 gallons per day of sulphite liquor. If we add to that the wastes from other mills we see the enormous quantity of material which is thrown in day after day. This increases the amount of organic matter which is already naturally rich in the Ottawa River, so that in some spots oxygen is considerably reduced at some time of the year and fish die of asphyxiation. The wastes are an excellent medium for the propagation of bacteria, which can be detrimental to human and animal life. All the solids, even those of inert composition, will cover the bottom of the river and spoil the natural habitat of animal ; close inspection may find a mat many feet thick.

Although some methods of preventing pollution by the pulp and paper industry are known and could be used, much is needed to reduce the cost. The ideal solution would be to transform waste into by-products. This is what industry is trying to achieve without much success so far. Until now only alcohol and several secondary products have been manufactured.

MINES

Close to the head of the Ottawa River are the famous Mines of gold and copper at Rouyn-Noranda, wastes of which have destroyed fish and practically all animal life in the adjacent lakes. In other places, we note extraction of calcium, iron, feldspar, granite, magnesite, molybdenite, dolomite, lead, silica, zinc : all these, to some small extent, pollute our waters. Sedimentation lagoons could be a lot of good here.

Textiles

There are 6 textile mills on the Quebec side.

This industry requires great quantities of water as pure as possible ; usually it must treat it before use - the wastes are very harmful but their danger can be reduced by using fine mesh filters, maintaining good aeration in the sedimentation lagoons, provoking chemical precipitation and ending the treatment with a bio-filter.

Tanneries

Water is again necessary for the processing of leather, but to a lesser degree than with textiles. The resulting sewage has a revolting odour but can be adequately treated by various processes such as chemical precipitation and filtration or else by coagulation and sedimentation.

Other industries

I do not intend to list all the kinds of industries to be found in the Island of Montreal, requiring over 300,000,000 gallons of water a day. A single refinery devours up to 35,000,000 gallons. Unfortunately all these plants pollute the water of the river Ottawa that surrounds the Island of Montreal and Ile Jesus.

6. Waste carrier

This title may surprise the conservationists, since practically any waste is bound to impair the quality of water and be contrary to the established laws. That is true, but we must realize that, with the development of industry and population, it is practically impossible not to have waste in our streams. There is however a great difference between the present general practice of throwing everything in the river and the policy of retaining most of the waste by methods already known. Here we must consider not only the waste that we deliberately throw into our water, but also that which reaches the rivers independently of our will.

Those who have claimed that dilution and self-purification were sufficient to take care of used waters can see today where this harmful policy has driven us when they see the offending condition of the Ottawa River between Ottawa and Montreal.

Our streams and lakes have been turned into open cesspools. Self-purification may perhaps improve the water far downstreams from the sources of pollution but what can be said for the closer neighbourhood ? Diluting soiled water to camouflage pollution will not always be successful when it is known that currents of different densities do not mix and that molecules have between one another a real force of attraction and cohesion. You only have to glance at the demarcation line between the waters of the St. Lawrence and the Ottawa which shows up as far as south of Three Rivers. If dilution worked so well, the difference in the degree of pollution would not be so great between the water in

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the middle of the St. Lawrence and that which bathes the shores of Montreal Island. Which does not mean you cannot, to some extent, rely on these phenomena of dilution and self-purification acting further upon waters already purified to the maximum extent.

As it is not possible with our present methods to obtain 100% purification, we shall require these phenomena to conclude our cleaning processes and we shall need all the water we can get. This leads me to protest against any diverting of water that might reduce the flow of a river. In some cases even, we shall have to build storage reservoirs to supply our needs in times of drought. Our rivers will not only have to take care of domestic and industrial wastes, but also of all that is carried down during storms. We could also wonder whether we should not build sedimentation tanks to collect surface waters. These tanks would hold back silt and other solids washed down by the rain.

Even with the best purification plants available, we can't prevent nitrates and phosphates fertilizing our waters and stimulating the growth of harmful algae. Furthermore, detergents come through unscattered: they have been detected as far as 1000 miles downstream and these days you are quite likely to drink water containing detergents because the chlorination that takes place in filtering plants does not alter their nature. What the ultimate effect on human beings will be, no one can say.

The nuclear tests recently undertaken by Russia have tremendously increased the amount of radioactivity in the air which finally reaches the water and pollutes it. The recent reference to poisoning of ducks by radioactive material following nuclear tests is quite a warning of what can happen. There are many gases such as hydrocarbons, sulfurous components, fine solid particles such as fly ash . . . etc. which eventually pollute water. The noxious effects are first felt while they are in the air, but since those reservoirs containing water for drinking or alimentary purposes are usually open, they, too, will become contaminated by fall out.

Cost and benefits.

The economic importance of the Ottawa river watershed rests mainly on its proximity to the Canadian metropolis: generally speaking we find here a population of nearly 2,000,000 inhabitants which represent two fifths of the province of Quebec. It is obvious that the Montreal region suffers from that pollution. If the wastes from the Montreal area are added, no one will be surprised to find the St. Lawrence polluted as far as Quebec City and beyond, to the wholesale detriment not only of the riverside dwellers but also of all that region which is of such vital importance to the economy of our province.

We cannot hesitate. It is most urgent that the increase in the pollution of our waters be stopped and, next, that used water be adequately treated. We still meet some people who lag behind and are opposed to these plans on pretext that "it will cost a lot and won't pay". Such an attitude is contradicted by the facts, if you take time to look into them. The costs of building and operating a purification

plant for the treatment of domestic sewage amounts to less than a penny a day per person, which is very little compared to its advantages. There is nothing to be feared, especially when each municipality can generally receive federal and provincial help. In the Province of Quebec, the Municipal Affairs Commission examines the financial situation of municipalities and reports to the Water Purification Board.

In the past, we must admit, some of our industries were loath to treat their wastes because of the cost and because "others" were doing nothing: in a way, you can't blame them for their line of thought. But on the other hand, other industrialists, perhaps more civic-minded, have stepped forward and set an example; they also benefited from this. In this field as in others, an example starts the ball rolling. If the great industries decide to treat or improve the treatments of their wastes, the day will be won.

In future, industry will always have to reckon with the cost of water purification in its operating cost. Water pollution is such a serious matter, such an urgent matter that the governments should consider, when real financial difficulty is met, some form of fiscal rebate to the industries that will purify their waters or prevent pollution. The governments could rely on reports prepared by an economic Committee. On the provincial scale, the Water Purification Board has already an Advisory Board chosen from several fields, which could fill that duty.

Water pollution in the province of Quebec is such that it means a real loss of millions of dollars; it is obvious that both prevention and control of water pollution are costly at the start. But it is also certain that the economy at large will benefit. The "money" question, important as it is, must not overshadow the purely human interests. Our population has an absolute right to the usage of natural resources. Unpolluted lakes and streams are a capital investment, as are outdoor sports. Is not a Sunday angler who whiles away a few hours dipping his line off the quay side or from a boat just as contented as the millionaire who flies at great cost to seek his game in the distant lakeshores of Ungava! Water purification is therefore an economic and humanitarian necessity.

CONCLUSION

Some administrators advocate the classification of rivers, such as for drinking purposes, bathing, domestic, industrial uses; this might at first sight seem logical, but it is not too practical in a country which is in active development, such as our own, since this would rouse much sharp differences of opinion and lead to switches of classification. It seems better to state that anyone who has waste to deliver in our waters must use the best known equipment to prevent pollution. Then a maximum permissible concentration of waste elements should be established by the Water Purification Board and this independently of the volume of the receiving waters. However, a permissible maximum total amount of waste produced by all involved will have to be determined in relation to the minimum flow of the river;

otherwise no new development should take place, unless there is some improvement in the methods of water purification, which should be put to work in a reasonable time, this to be determined by the Board.

In summary, any change of the nature of the water should be prevented, especially if such a change produces an excessive bacterial, physical or chemical contamination, or if unnatural deposits interfere with navigation, fish and wildlife, bathing or recreation or destroy esthetic values, or produce toxic substances and materials with objectional tastes and odors. If we do the utmost to prevent this, Canada will thrive, otherwise we shall be engulfed by pollution, and life will become unbearable. After all, we live on earth and not in outer space, at least not at the present time. If so many millions of dollars are spent to reach the moon, why should we not spend some to live in happy surroundings. If in the past people have been accustomed to a certain extent to live with water pollution, they should react now and combat it since they have means to do it. River boards made of citizens who are far-sighted in the development of their region should be formed forthwith, not for the purpose of fining people, but of convincing them, because I believe that conviction (persuasion) will give better results than conviction (condemnation).

On the technical side, the first step must consist in putting a research team to work to make a thorough survey of the Ottawa River watershed; the object is that of setting up a policy for making the most of the water for all its uses, i.e., a policy of equi-marginal utilization. Low altitude aerial photography is an early need; specialists must study the photographs as revealing intimately the constitution of the area, doing much of their work indoors. Then the outdoor work can be undertaken by landscapers, biologists, engineers, geographers, geologists, sociologists, etc.

In order to make maximum present and future use of our natural resources they must bear in mind the conservation principles enumerated throughout this brief paper.

Further, it is indispensable for the provinces of Ontario and Quebec to follow the same policy. Whichever province has the stricter regulations should set the standards for the other, as is done among the states of our neighbouring country. How simple it would be if sound international standards were everywhere followed. But perhaps that is asking too much of a world out of tune. At the beginning we stressed the need for setting up ideals, but this particular one seems beyond our present reach.

But if everybody is really cooperative and is sincerely convinced that pure water is prerequisite to any development, then we see no reason why our other ideals cannot be attained. Success is not a matter of technics alone, but also of people's minds. Since we live in a democratic world, we need to foster public enlightenment and only then will we be able to use the Ottawa River and its watershed, at the best advantage of the present and future generations.

**BASSIN DE LA RIVIÈRE OTTAWA
OTTAWA RIVER WATERSHED**



ALBERTA PROVINCIAL ARCHIVES
EDMONTON, ALBERTA



APPENDICE

Liste des sources de pollution de la rivière Ottawa et de ses tributaires.*

On compte approximativement 260 scieries qui sont indiquées sur la carte mais qui n'apparaissent pas dans la liste.

Si, après avoir jeté un coup d'oeil sur cette liste, l'on songe qu'une population de 1,300,000 déverse ses déchets et égouts dans une rivière dont le débit parfois n'atteint pas 30,000 pieds cubes par seconde, on ne s'étonne plus de constater le degré élevé de pollution qui y règne en ce moment.

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APPENDIX

List of sources of pollution on the Ottawa River and its tributaries.*

There are approximately 260 sawmills which are indicated on the map but are not listed hereafter.

When one glances at that list of establishments and thinks of the 1,300,000 people who throw their wastes in a river, the flow of which is sometimes less than 30,000 cubic feet per second, he cannot be surprised at the prevailing high degree of pollution.

* Cette liste, quoique assez complète, n'est pas exhaustive.

* That list although quite complete is not exhaustive.

CHAPTER

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ALIMENTS - FOOD PRODUCTSProduits de la viande : Meat products :

Canada Packers Ltd.,
210 rue Montcalm, Hull.

Salaison Régionale d'Evain,
Evain, Cté Témiscamingue.

Abbattoir des Pères Trappistes,
La Trappe, Oka, Cté Deux-Montagnes.

Cléroux, Henri,
Papineauville, Cté Papineau.

Ferme Avicole St-Raymond,
Piché, Georges, prop.,
101, rue St-Raymond, Hull,

Gratton, Acheman,
Oka, Cté Deux-Montagnes.

Legault Turkey Farm,
767 Boul. Labelle, Ste-Thérèse.

Rodger's Chicken Products Ltd.,
R.R.1, Lachute.

Sunny Brook Farm,
Ste-Adèle, Cté Terrebonne.

PRODUITS DU CAOUTCHOUC - RUBBER PRODUCTS

Dominion Rubber Co. Ltd.,
682 rue Labelle, St-Jérôme.

Precision Rubber Products (Canada) Ltd.,
156 rue Turgeon,
Ste-Thérèse de Blainville.

PRODUITS DU CUIR - LEATHER PRODUCTS

La Diva Shoe Ltd.,
998 rue Labelle, St-Jérôme.

Galibert Tannery Inc.,
Rigaud, Cté Vaudreuil.

National Heel Ltd.,
234 rue St-Paul, St-Jérôme.

TEXTILES - TEXTILS

Blenor Textiles,
St-Bruno de Guigues,
Cté Témiscamingue.

Textile St-Anne Ltée.
Rigaud, Cté Vaudreuil.

Ayers Ltd.,
Lachute Mills, Cté Argenteuil.

General Manufacturers Reg'd,
39 rue St-Jean Baptiste, Hull.

Holden Mfg. Co. Ltd.,
87 rue Montcalm, Hull.

Industrial Bag Co.,
rue Lois et Desjardins, Hull.

Laurentian Textile Company Limited,
St-Jérôme, Cté Terrebonne.

Ledoux, Henri,
Maniwaki, Cté de Gatineau.

Morrison B. Hugh,
Brownburg, Cté Argenteuil.

St-Andrews Woolen Mills Limited,
St. Andrews East, Cté Argenteuil.

Rosemere Draperies,
311 Grande Côte, Rosemère.

TRICOTS - KNITTING PRODUCTS

Hanson Mills Ltd.,
82 rue Front, Hull.

Hudson Hosiery Co. Ltd.,
Hudson, Cté Vaudreuil.

Hudson Hosiery Ltd.,
Rigaud.

Regent Knitting Mills Ltd.,
St-Jérôme, Cté Terrebonne.

PLACAGES ET CONTREPLAQUES - PLYWOOD AND VENEER MILLS

Bellerive Veneer & Plywood Ltd.,
Rue Iberville, Mont-Laurier

Dominion Ayers Wood Products Co. Ltd.,
Lachute

International Plywood Ltd.,
Gatineau

Singer Mfg. Co. (The)
Thurso, Cté Papineau

PRODUITS DES MINERAUX NON METALLIQUES - NON-METALLIC MINERAL PRODUCTS

Canada Cement Ltd.,
5 boul. St-Joseph, Hull

Aluminum Co. of Canada Ltd.,
Wakefield, Cté Gatineau

Canadian Refractories Ltd.,
Kilmar, Cté Argenteuil

Cross Walter C. Co. Ltd.,
209 rue Eddy, Hull

Mica Co. of Canada Ltd.,
4 rue Lois, Hull

PRODUITS CHIMIQUES - CHEMICAL PRODUCTSAcides, alcalis et sels - Acids, Alkalis and Salts

Electric Reduction Co. of Canada Ltd.,
Rue Short, Buckingham, Cté Papineau

Gaz comprimés - Gases compressed

Linde Air Products Co. Div. of Union Carbide Canada Ltd.,
Noranda, Cté Rouyn-Noranda

Explosifs, munitions et pyrotechnie - Explosives, ammunitions and pyrotechn

Canadian Industries Ltd.,
Brownsburg, Cté Argenteuil

Canadian Safety Fuse Co. Ltd.,
Brownsburg, Cté Argenteuil

PLACEMENT OF WORKERS IN THE FUTURE

Director General of Labour
The Ministry of Labour

Director General of Labour
The Ministry of Labour

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PLACEMENT OF WORKERS IN THE FUTURE

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Explosifs, munitions et pyrotechnie (suite)

Hand L.W. Fireworks Co. Ltd.,
Papineauville, Cté Papineau

Adhésifs - Adhésives

General Adhesives Ltd.,
St-Janvier, Cté Terrebonne

PRODUITS DU PAPIER - PAPER PRODUCTSMoulins à pulpe - Pulp mills

Canadian International Paper Co.,
Témiscamingue, Cté Témiscamingue

Thurso Pulp & Paper Co.,
C.P. 130, Thurso, Cté Papineau

Wilson J.C. Ltd.,
St-Jérôme, Cté Terrebonne

Moulins à pulpe et à papier - Pulp and paper mills

Canadian International Paper Co.,
Gatineau

Eddy E.B. Co., (The),
Rue Eddy, Hull

International Fibre Board Ltd.,
Gatineau

Maclaren, James Co. Ltd.,
Buckingham, Cté Papineau

Masonite Co. of Can. Ltd.,
Gatineau

Moulins à papier - Paper mills

Rolland Paper Co. Ltd.,
Mont-Rolland, Cté Terrebonne

Rolland Paper Co. Ltd.,
St-Jérôme, Cté Terrebonne

Wilson J.C. Ltd.,
Lachute

Section 1 - General

Section 1 - General
This section contains the general provisions of the Act.

Section 2 - Definitions

Section 2 - Definitions
This section defines the terms used in the Act.

Section 3 - Powers and Duties

Section 3 - Powers and Duties

Section 3 - Powers and Duties
This section sets out the powers and duties of the various authorities.

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Section 4 - Penalties

Section 4 - Penalties
This section sets out the penalties for breaches of the Act.

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Section 5 - Miscellaneous

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This section contains miscellaneous provisions.

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SYMBOLES - SYMBOLS

Colonne: Genre de Fabrique (Basé sur l'outillage)
Column: Kind of Plant (Based on equipment)

- B - Beurrerie - Butter
F - Fromagerie - Cheese
BF - Beurrerie & Fromagerie - Butter and cheese
PE - Poste d'écémage ou de réception - Creaming or receiving station
L - Laiterie - Dairy
C - Condenserie - Condensed milk
CG - Crème glacée - Ice cream
LP - Poudre de lait - Powdered milk
R - Beurre retravaillé seulement - Processed butter only
P - Fromage refait seulement - Processed cheese only
CA - Caséine - Casein

ARGENTEUIL

- BF Arundel Butter & Cheese Factory (Arundel)
F Leclair, Romuald (Harrington) B. P. Revington
BCA Crèmerie de (Lachute)
L Bradford's Dairy (Lachute) (Lowe Bros).
L Laiterie R. Lemay (Brownsburg)
L Granham Dairy (Geo. Granham)
L Laiterie Lacasse (Brownsburg)

DEUX MONTAGNES

- BF RR. PP. Trappistes (Oka) B. P. La Trappe.
BL Comtois, Isidore (St-Eustache).
BCAL Vitalas Ltée (St-Placide).
B Côté, Richard (St-Joseph-du-Lac) Pointe Calumet.
BCA Brunet, Réal (St-Benoît).
B Brière, Charlemagne, (St-Augustin)
B Léonard, Chs.-Ed. (Ste-Monique)
B S.C.A. de (Ste-Scholastique) rg Belle-Rivière.
B Roy, Emile (St-Augustin) rang Petit Brûlé.
B S.C.A. de (St-Eustache) rang Grande Frenière.

Journal of the American Statistical Association

[illegible]

57 - *Barbetta & Longobardi - Italian and Chinese*

10 - 100% Increase in the volume of - Growing or recovering market

[illegible]

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also noted by [redacted] - [redacted] [redacted] [redacted] - [redacted]

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1998 - 1999 - 1999

10. *Journal of the American Statistical Association* 93 (1998), 1100-1110.

1. *Staphylococcus aureus* (Dermatophytes)

1. $\lim_{n \rightarrow \infty} \frac{1}{n} \sum_{k=1}^n f\left(\frac{k}{n}\right) = \int_0^1 f(x) dx$

(ကုမ္ပဏီ) မှာပါ ဖြစ်ပါသည်။

C. Injektive Abbildung (Injektivität)

23704A 7910AM 307302

10. *Journal of the American Statistical Association*, 1997, 92(439), 1093-1103.

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- B Dion, Gaudias (Ste-Cécile-de-Masham).
- B S. C. A. de (Bouchette).
- F Soc. de Patrons de Beech Grove (Eardley) rang II.
- B Beurrerie Coop. de (Gracefield).
- B L S. C. A. de (Maniwaki).
- F Soc. de Patrons de (Luskville).
- B Gatineau Coop. Creamery (Farrelton).

HULL

- F Rollin, Albert (Templeton) rang 7 B. P. Ste-Rose-de-Lima.
- F Lavigne, Rosario (Templeton) rg Coussineau B. P. Ste-Rose-de-Lima
- L PE Clark Dairy Ltd. (Hull) 634 Bronson Ave. Ottawa.
- L Ottawa Dairy Sommerset Street, Ottawa.

LABELLE

- B S. C. A. de (Lac-des-Iles)
- B Larocque, Alcide (Nominique)
- B S. C. A. de (Ferme-Neuve)
- B S. C. A. de la Rivière-Rouge (L'Annonciation)
- B S. C. A. de (Ste-Anne-du-Lac).
- F Soc. de Patrons de (Ferme-Neuve).
- F S. C. A. de l'Ascension.
- B Soc. de Fab. de B. & F de (Mont-St-Michel) rg I.
- B Crèmerie Larose (Mont-Laurier) Lucien Larose.
- B S. C. A. de la Vallée de la Lièvre (Mont-Laurier).
- L Laiterie Mont-Laurier Enrg. L. Grenier Prop. (Mont-Laurier).

PAPINEAU

- F Soc. de Patrons de Priest Creek (Portland-Ouest) B. P. Poltimore.
- F Silver Creek Cheese Factory (Locheber-Ouest) R. R. I Thurso.
- F The Poltimore Cheese Co. (Portland-Ouest).
- F Soc. de Patrons de Glen Almond (Buckingham).
- B Gagnon, William (Chenneville).
- BF S. C. A. de (St-André-Avellin).
- B S. C. A. de (Thurso).
- B S. C. A. de (Notre-Dame-de-La-Salette).
- B Parenteau, René (Ripon).
- F Soc. de Patrons de Poltimore (Portland-Ouest) B. P. Holand Mills.
- B Lalonde, P. H. (Suffolk & Addington) B. P. Namur.
- F Prévost, Mme Vve Roméo (Ripon) rang Valencey.
- F Meyer, E. E. Henry (Ponson by) rang 4.
- F Soc. de Patrons de (St-Malachie) R. R. I
- B Crèmerie de (Papineauville).
- F Mongeon, Albert (Angers) rang 2.
- F Maisonneuve, Adoris, (Angers).

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1	1. C. A. de la Vallée de la Rivière (Maison-Laurier).
2	2. C. A. de la Vallée de la Rivière (Maison-Laurier).
3	3. C. A. de la Vallée de la Rivière (Maison-Laurier).
4	4. C. A. de la Vallée de la Rivière (Maison-Laurier).
5	5. C. A. de la Vallée de la Rivière (Maison-Laurier).
6	6. C. A. de la Vallée de la Rivière (Maison-Laurier).
7	7. C. A. de la Vallée de la Rivière (Maison-Laurier).
8	8. C. A. de la Vallée de la Rivière (Maison-Laurier).
9	9. C. A. de la Vallée de la Rivière (Maison-Laurier).
10	10. C. A. de la Vallée de la Rivière (Maison-Laurier).

- B S. C. A. de (Buckingham).
- B S. C. A. de (Notre-Dame-du-Laus).
- L Laiterie Château (R. Séguin) Buckingham.

PONTIAC

- B Quyon Farmer's Coop. (Quyon).
- B Producers Dairy Ltd. (Campbell's Bay).
- B LP Producers Dairy Ltd. (Shawville).
- F Clarendon Dairy Co (Shawville) R±R± 2.

TEMISCAMINGUE

- B Fabrique Coop. de (St-Eugène-de-Guigues) rang 8.
- B Coop. de Fab de Beurre de Bearn (St-Placide) rang 7.
- B Lafrenière, Armand (St-Isidore) B.P. Laverlochère.
- B S. C. A. de (St-Edouard-de-Fabre) rang 3.
- B Fabrique Coop. de (St-Bruno-de-Guigues) rang 4.
- B S. C. A. de (Lorrainville).
- B La Coop. de Beurre de (Ville-Marie).
- B S. C. A. de St-Joseph-du-Nord (Notre-Dame-des-Quinzes)
- B Fabrique Coop. de (Fugèreville) rang 9.
- B Fabrique Coop. de (Nédelec) rang 3.
- B Fabrique Coop. de (Latulipe) rang 8.
- B Fabrique Coop. de (Montbeillard) rang 3.
- L Noranda Dairy (Noranda) H.-J. Anderson.
- L Northern Dairy (Rouyn F. Rubec
- CG Laiterie A. Guertin (Rouyn).
- L Laiterie Dallaire (Rouyn)
- L Laiterie Kravetz (Rouyn)
- L Boyce Dairy (Témiscamingue).
- L Laiterie Belleterre (Belleterre).

TERREBONNE

- F Prud'homme, Alphonse (Breboeuf) rang 2 B.P. St-Jovite.
- L Léveillé, Rosaire (Ste-Thérèse-de-Blainville).
- B Plante, Athanase (St-Janvier-de-Blainville).
- B S. C. A. de (Ste-Sophie) de Lacorne.
- B Lessard, Gérard (Ste-Adèle).
- B S. C. A. des Fermes du Nord (St-Jovite)
- F Piché, Henri (Bréboeuf).
- B S. C. A. de la Rivière du Nord (St-Jérôme).
- L Crèmerie St-Jérôme (St-Jérôme) F. Casavant.
- L Laiterie Jérômiennne (St-Jérôme) C.E. Huot.
- L Laiterie des Laurentides (Ste-Agathe).
- L Laiterie St-Jovite (M. Léonard Prop.).

VAUDREUIL

- B S.C.A. de (Ste-Justine-de-Newton).
 F Hamelin, Georges (Ste-Justine-de-Newton) rg Station.
 F Synd. de Fromagerie de l'Anse à la Raquette (Rigaud)
 B S.C.A. de (Rigaud)
 B S.C.A. de (Ste-Marthe).

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GENERAL - 1957

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Prévost, Gustave
The Ottawa River

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